Oldenburg Measurement Applications

Software package for
audiometric and diagnostic
measuring methods

Technical specifications

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2 General remarks

The following documentation describes technical prerequisites for running the “Oldenburg Measurement Applications“ and gives recommendations and examples for an appropriate set-up of the measurement equipment. Such measurement equipment is not available as a finished product according to the regulations of medical devices, but has to be finished or assembled by the user. Installation and use of such measurement equipment are at the user’s own risk and may require an approval by the responsible persons and/or commissions in the enterprises or research institutions, where this equipment is used. Specifications are subject to changes.

Note

Under the general title ‘Oldenburg Measurement Applications’, HörTech gGmbH offers different computer programs (software) for performing audiological and other measurements. These computer programs may be used only at the user’s own risk and for research, teaching and training purposes, exclusively (the software is not approved as medical device according to the regulations for medical devices, e.g. 93/42/EEC or others).

Additional appropriate equipment (hardware) is necessary to run the computer programs. This equipment includes a PC, audio devices (e.g. sound card), an audiometer as well as transducers (loudspeakers, headphones and the like). A system for performing the computer programs is installed and used always at the user’s own risk. The legal regulations must be obeyed for which the user takes responsibility. Installation, calibration and operation of such a system require relevant technical knowledge as well as appropriate devices and auxiliary units, respectively.

3 Technical prerequisites

3.1 System standards PC

The PC used must meet at least the following standards:

- Operating system Microsoft™ Windows™ 98, ME, 2000 or XP (™ each)
- Processor Pentium 3, 1 GHz
- 256 MB main storage (or more, if recommended by the manufacturer of the operating system)
- Monitor at least 1024x768 pixels, 24-bit true-color (first monitor)
- CD-ROM or DVD-ROM drive
- Hard disk with at least 1 GB free disk space (depending on the measurement software installed; depending on the extent of measurements and required signals also single measurements may require more space; details are given by the respective installation software)
- a free serial interface for a PC-controlled audiometer (if used)
- a free serial interface for a touch screen monitor or an external response box (if used); alternatively, a USB port may be necessary depending on hardware)
- a free USB connection or a parallel interface (printer connection) for the hardware copy protection (= Dongle, if the parallel interface is used, a printer may be connected simultaneously)

3.2 Response box

During the measurements the experimenter or the test subject has to give a response as reaction to the presentation of acoustic signals. According to requirements this response can be given using the following devices:

- by mouse click on the screen (as first monitor or second monitor via a second or special graphics card if supported by the operating system, generally from Windows ME on)
- with a finger on a touch screen monitor (as first monitor or second monitor via a second or special graphics card if supported by the operating system, generally from Windows ME on)
- PC / notebook with serial interface and Windows 9x/ME/2000/XP (upon request)
- Windows CE – compatible handheld/tablet PCs or the like with serial interface (upon request)
- Epson handheld PC EHT-10 (hardware no longer available on the market)

3.3 Audio devices

3.3.1 Sound card, digital/analogous converter

For an audio presentation via sound card (audio device of the PC), a high-quality sound card with accordingly high-class digital/analogous converters must be utilized.

The following sound cards are recommended:

RME DIGI96 Series

RME (http://www.rme-audio.de) produces the sound card model DIGI96/8 PAD with digital interfaces and integrated D/A-converter is being manufactured. The integral D/A-converter (stereo) is sufficient for simple applications. For high quality demands it is recommended to use a high-quality external D/A-converter, for example the model ADI-8 PRO produced by RME. If an external D/A-converter is used, the integral D/A-converter is not necessary. This production of this sound card is discontinued.

If the integrated D/A-converter is used the settings in the manufacturers settings dialog (see operating manual of manufacturer) have to be checked: all volume sliders should be switched to their maximum, no additional attenuations (if any) should be switched on. However, none of these settings must be changed after the system was calibrated.

RME HDSP 9632

RME (http://www.rme-audio.de) produces the sound card model HDSP 9632 with digital interfaces and integrated D/A-converter is being manufactured. The integral D/A-converter (stereo) is sufficient for simple applications. For high quality demands it is recommended to use a high-quality external D/A-converter, for example the model ADI-8 PRO produced by RME. If an external D/A-converter is used, the integral D/A-converter is not necessary.

If the integrated D/A-converter is used the settings in the manufacturers settings dialog (see operating manual of manufacturer) have to be checked: all volume sliders should be switched to their maximum, no additional attenuations (if any) should be switched on. However, none of these settings must be changed after the system was calibrated.

Attention: It is principally not advisable to utilize sound cards that are not mentioned in the list above. Utilization of many sound cards may alter the signal level of the audio output by other implementations (e.g. games, multimedia applications, web applications etc.). This may result in an incorrect calibration of the audio output for single or all measurements afterwards.

3.3.2 Audiometer

An audiometer is necessary for the audio output in case of many measurements. Additionally, the audio output must be calibrated with the corresponding transducer (headphones and loudspeakers, respectively). The audiometer is controlled by the software via a serial interface or the like. The following audiometers are supported (please also note the remarks below):

- Siemens PC Audiometer Unity (SD100)
- Madsen/GN Resound Audiometer Aurical or Aurical+
- Research audiometer „Gö-Audiometer“ of Göttingen University (called Bluebox or Greybox, hardware not available on the market)
- All-digital level adjustment without audiometer (with limited dynamic range)

For certain audiometers/hardware configurations, the following peculiarities or restrictions have to be taken into account:

Unity (SD100): At high output levels (above ca. 60-70 dB) the residual/inherent noise of the audiometer is audible in the output signal; its level also rises with increasing output levels.

Aurical: Utilizing the headphones Sennheiser HDA200 it has to be considered that the maximally obtainable sound pressure level is limited (to significantly less than 100 dB, which may, however, vary considerably depending on the signal/frequency), because of the electrical output level.

Fully digital level adjustment: Here, the dynamics of the audio signals is restricted to the dynamic range of the D/A-converters (e.g. of the sound card). This implies that an audible quantization noise occurs in case of high attenuation. Therefore, this configuration is perhaps unsuitable for certain measurements and/or requirements.

3.3.3 Transducers

Sennheiser HDA200 are the recommended headphones, because these circumaural audiometry headphones enable a high reproducibility of the presented sound pressure level even at high frequencies. The models DT48, TDH-39 and TDH-39P are also supported. When selecting the headphones in the software (hardware adjustments) it is important to select the exact type of headphones, especially considering the difference between TDH-39 und TDH-39P.

Attention: Usually, the audiometer must be especially calibrated or adjusted by an expert before utilizing a certain type of headphones. The headphones to be used must be specified in the software settings. If other headphones are selected, false, uncalibrated signals and incorrect measurements may occur.

As free-field loudspeakers principally high-quality loudspeakers from the field of professional studio techniques are recommended, e.g. monitor boxes (active boxes) with a correspondingly flat transfer function in the required frequency range. **Attention:** The required frequency range may also depend on the respective measurement, e.g. on the frequencies applied for loudness scaling.

Principally the free-field loudspeakers on the market are subject to rapid changes and product cycles are so short sometimes that no specific model from a certain manufacturer can be recommended. Moreover, the demands on the loudspeakers may be quite different. For example, a loudspeaker that is especially suitable for representing very high sound pressure levels may be very noisy at lower levels and thus unsuitable for near-threshold measurements. Depending on the requirements, active as well as passive loudspeakers with a fitting final amplifier may be suitable. A loudspeaker (and, if required, a final amplifier) should be chosen by an expert considering the individual demands. It has to be taken into account that fairly high sound pressure levels within the range of 90 to 100 dB HL may be required for some measurements such as loudness scaling in case of narrow-band signals.

4 Set-up of measuring equipment

4.1 Audiometer "Bluebox" / "Gö-Audiometer"

Figure 1 shows the cabling connecting the single components of the measuring equipment employing an audiometer of the type "Bluebox" / "Gö-Audiometer". This research audiometer was developed at Drittes Physikalisches Institut (DPI) of Göttingen University. Early series have a blue case without inscription (called "Bluebox"). New series have a grey case with the inscription "Gö-Audiometer" (called "Greybox"). Connection of an external response box and a CD player is optional. As free-field transducers active and passive boxes with an appropriate amplifier can be utilized alternatively. The specifications given by the manufacturer are to be observed.

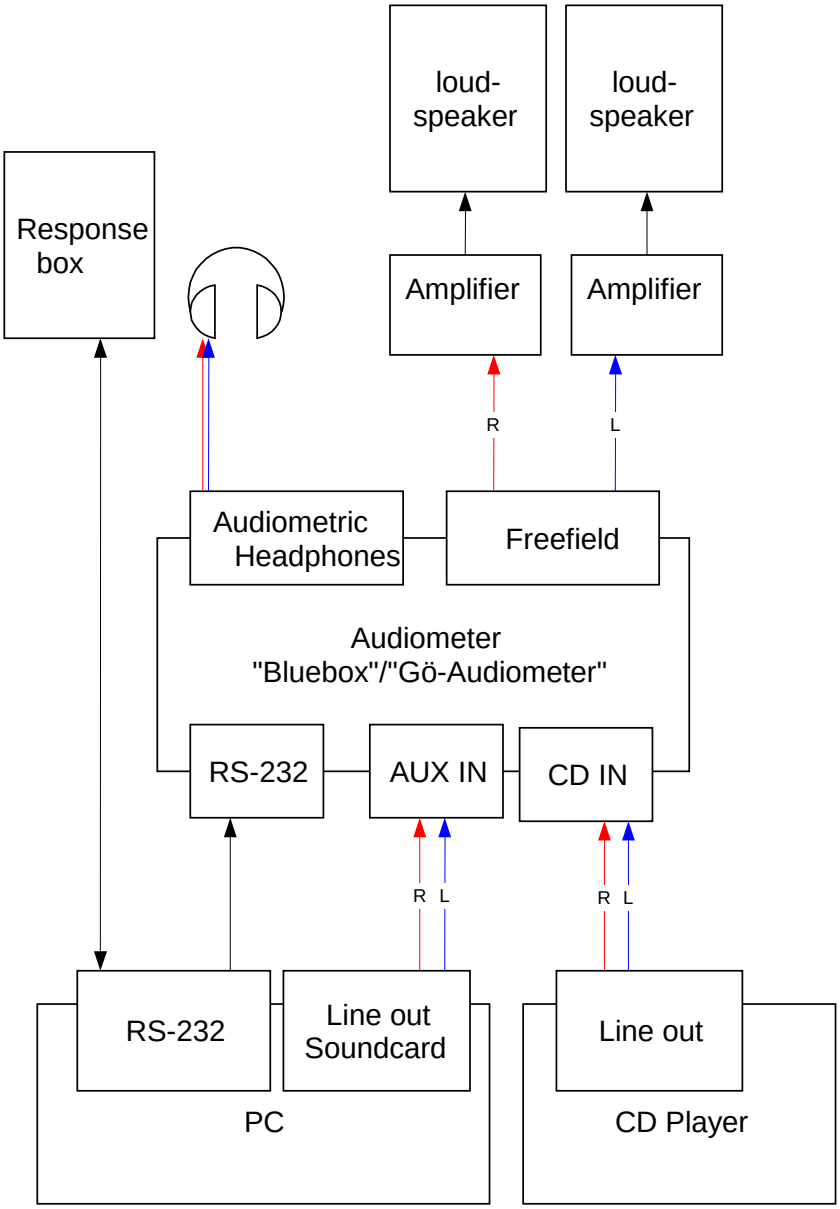


Figure 1

4.2 Audiometer “Unity”

Figure 2 shows the cabling connecting the single components of the measuring equipment employing an audiometer of the type “Unity”. Connection of an external response box is optional. As free-field transducers active and passive boxes with an appropriate amplifier can be utilized alternatively. The specifications given by the manufacturer are to be observed.

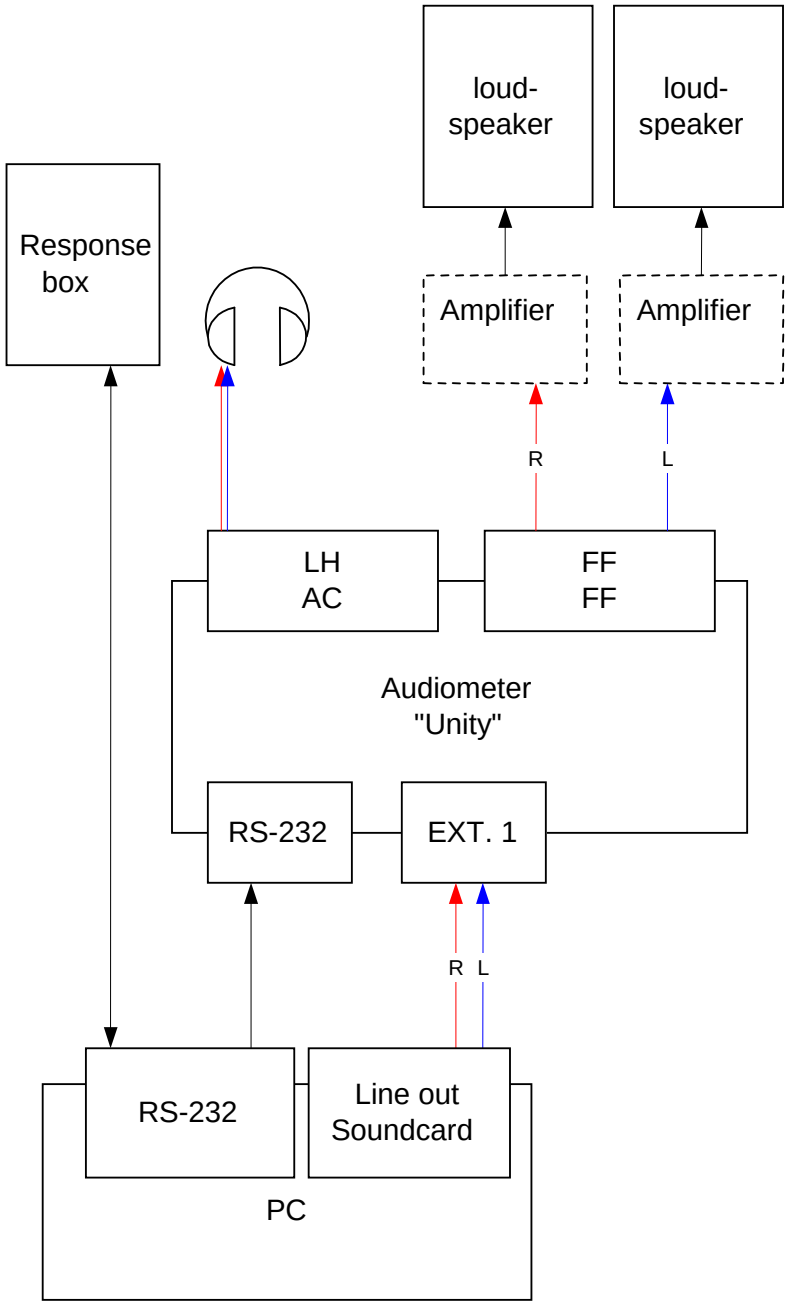


Figure 2

4.3 Audiometer “Aurical/Aurical+”

Figure 3 shows the cabling connecting the single components of the measuring equipment employing an audiometer of the type “Aurical” (serial RS-232 interface) or of type “Aurical+” (USB interface). Connection of an external response box is optional. As free-field transducers active and passive boxes with an appropriate amplifier can be utilized alternatively. The specifications given by the manufacturer are to be observed.

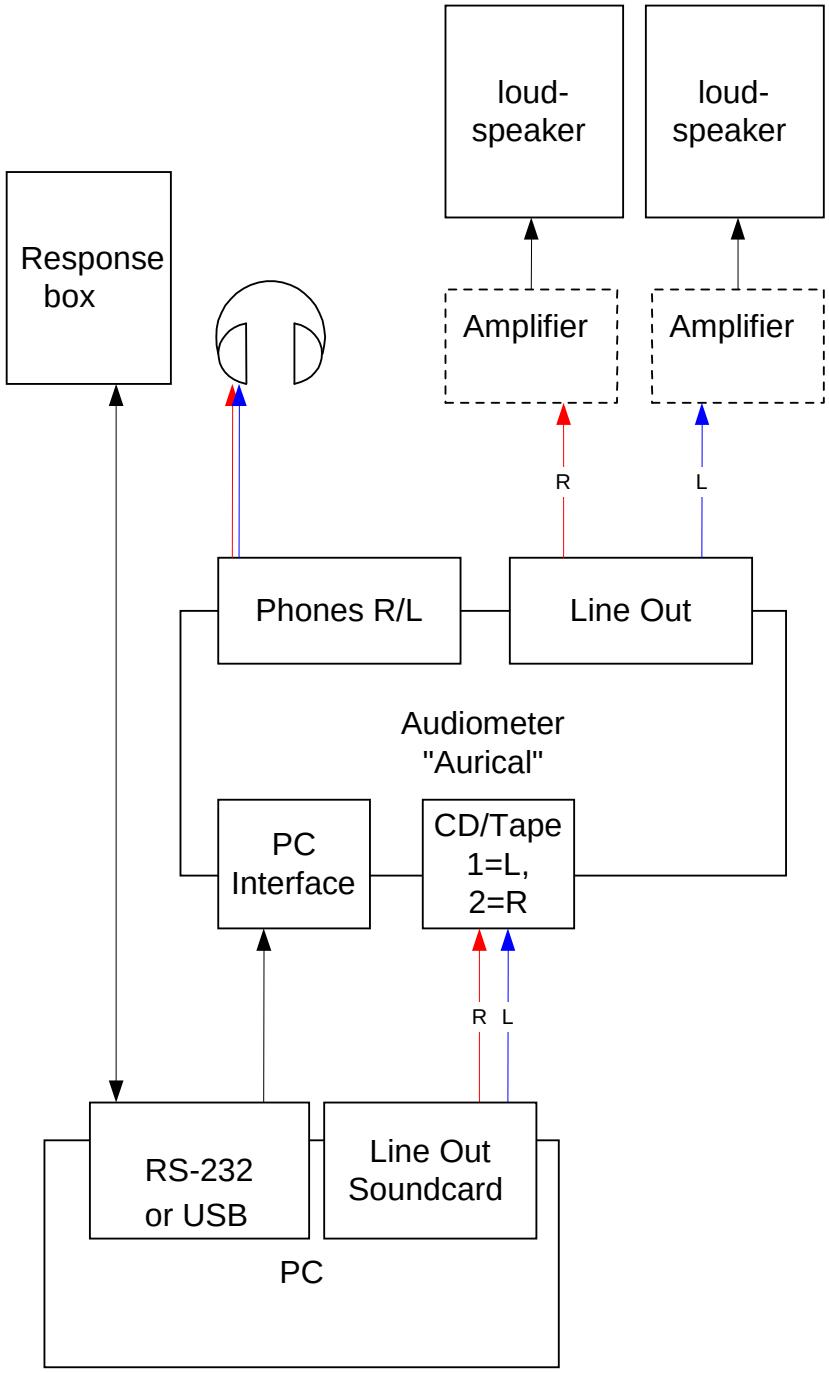


Figure 3

4.4 All-digital level adjustment

Figure 4 shows the cabling connecting the single components of the measuring equipment employing an all-digital level adjustment (without audiometer). This configuration requires two stereo channels (sound card and D/A-converter with at least two stereo output terminals) for simultaneously connecting headphones and free-field loudspeakers. Connection of an external response box is optional. As free-field transducers active and passive boxes with an appropriate amplifier can be utilized alternatively. The specifications given by the manufacturer are to be observed.

Attention: For an all-digital level adjustment, the dynamics of the audio signals is restricted to the dynamic range of the D/A-converters (e.g. of the sound card). This implies that an audible quantization noise occurs in case of high attenuation. Therefore, this configuration is perhaps unsuitable for certain measurements and/or requirements.

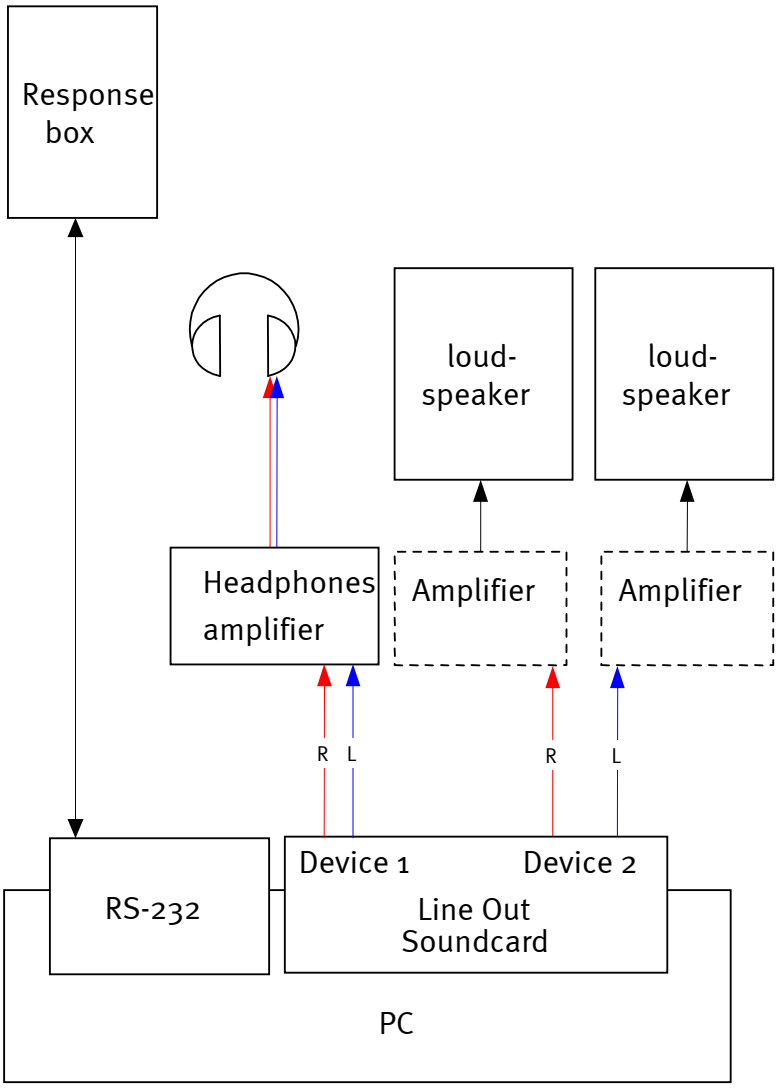


Figure 4

4.5 Additional CD audio presentation

When “Oldenburg Measurement Applications” are performed, audio signals are usually displayed via a sound card of the PC. In certain cases it may become necessary to additionally employ the CD drive of the PC for an audio CD, e.g. for performing an audiological test from a CD. Various manufacturers offer software for this purpose, which enables an audio CD to be played in the CD ROM drive of the PC simultaneously controlled by the audiometer, if required.

In order to enable the above-described operation in one system together with the “Oldenburg Measurement Applications” (i.e. temporally alternating between the two operating modes), the CD drive must be connected appropriately.

Attention: In any case it has to be taken care that in every operation system (sound card or CD drive as signal source) the correct and suitable calibration of the audiometer is employed, e.g. the corresponding input sensitivity of the external signal input. While running the “Oldenburg Measurement Applications”, the audiometer is adjusted as determined upon calibration.

4.5.1 Shifting between sound card and CD drive

In case the devices do not enable the sound card and the CD drive to be operated simultaneously or both operating modes are to be used completely independently of each other, a change-over switch can be inserted upstream of the external system input of the audiometer. Such a change-over switch has two inputs A and B and one output connected with the external signal input of the audiometer (inputs and outputs in stereo each). The output of the sound card is connected with the input A of the change-over switch (Line Out), the analogous output of the CD drive is connected with the input B (also Line Out). Care has to be taken for the different operating modes that the change-over switch connects the right signal source (sound card or CD drive) with the external signal input of the audiometer.

4.5.2 Connecting the CD drive with the sound card

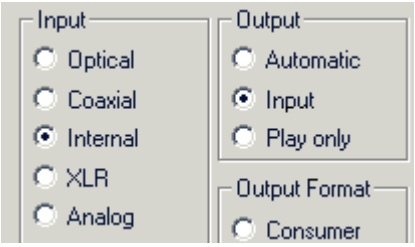
If one of the recommended sound cards with a digital (bipolar) input for CD audio on the sound card and a CD drive with a compatible digital audio output are used, the CD drive can be directly connected to the sound card via these two connections and an appropriate cable.

The correct adjustment for normal operation of the recommended sound cards with the “Oldenburg Measurement Applications” are indicated upon installation and configuration of the “Oldenburg Measurement Applications” and are described in the documents that go with the programs. For operation with a connected CD drive (as described in this section), the set-up may have to be changed or adjusted accordingly.

To sound cards of the series RME DIGI96/8 the following applies:

In the sound card the parameter “Input“ has generally been set to “Optical” and the parameter “Output” to “Play Only” by the accompanying software from the manufacturer.

For operation with the connected CD drive (as described above) the parameter “Input” is set to “Internal“ and the parameter ”Output“ is set to ”Input“ (see figure on the right).



With these parameter adjustments an audio signal (WAVE audio or .WAV file) displayed on the PC is presented via the sound card as in normal operation. Additionally, however, the audio signal of the CD drive is switched to the output of the sound card, while an audio CD is played on the CD drive (if the PC does not play an audio signal itself).

4.6 Response box Windows™ and Windows™ CE

According to requirements and on demand also separate PCs (e.g. laptop) or tablet PCs (operating system Windows™ CE) can be used as external response box (depending on operating system and hardware).

For this purpose the user needs a separate program which has to be copied to the PC/device used as response box and has to be started from there. Such a program can be obtained from the HörTech gGmbH stating technical details (operating system, hardware).

Generally, the response box must be stated as input device in the hardware settings of the "Oldenburg Measurement Applications" as well as an appropriate available serial interface for the connection with the response box. Care has to be taken that no other software and/or driver (e.g. for touch screen monitor or mobile units) occupies that serial interface.

If a normal PC or laptop/notebook is used as response box, the program RBOXE.EXE has to be copied from an appropriate data carrier or from the network to the hard disk of the response box PC. When the program has been started, the option dialogue can be selected by the right-hand mouse button. There again, an appropriate available serial interface for the connection with the measurement device has to be stated. The two serial interfaces on measurement device and response box must be connected with a suitable null-modem cable.

If a tablet PC with the operating system Windows™ CE is used as response box, the program RBOXE.EXE (suitable for the used hardware/CPU) has to be copied to the response box, too. For this purpose, appropriate software from the manufacturer on the response box and appropriate software on the server PC that is connected to the response box (as mobile device) must be employed. Usually, such software is provided by the manufacturer. If the program RBOXE.EXE is available on the response box, operation and connection are the same as described above for a laptop or the like. Care has to be taken that the serial interface in the system software of the response box may have to be released so that it can be used by RBOXE.EXE (e.g. if the serial interface is permanently occupied by the system software for the connection between the mobile device and the server PC). If the program RBOXE.EXE is started from a tablet PC, a right-hand mouse button is not necessarily available for selecting the corresponding functions via the context menu. In that case, the context menu can be activated by tapping into the left upper corner and then into the right lower corner with the pointer (corresponding to the left mouse button).

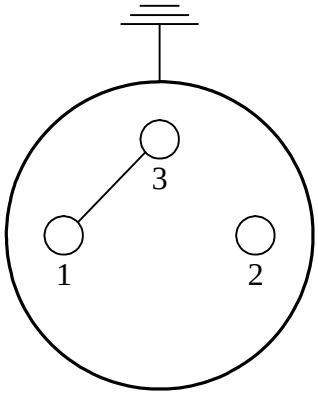
5 Audiometer “Bluebox”/”Gö-Audiometer”

5.1 Pin assignment “DA IN” / “AUX IN”

In the research audiometer “Bluebox“ and “Gö-Audiometer” (also called “Greybox“), there are principally two known versions of pin assignment to the XLR-plug sockets ”AUX IN“ and “DA IN“ (although individual variations or special designs are possible which have not been mentioned here). If not known, the pin assignment must be verified by looking into the device.

5.1.1 Version A

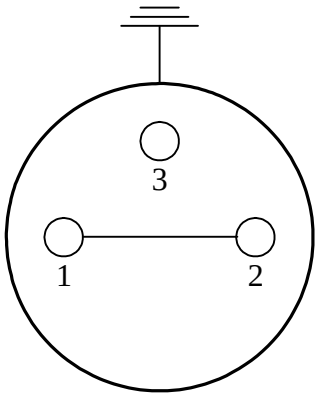
This version corresponds to the pin assignment in asymmetrical cables (single-line + shield) usually employed in studio and music equipment. It is available in new or converted audiometers:



1 – GND
2 – Signal
3 – GND

5.1.2 Version B

In part of the older audiometers the following version is found:



1 – GND
2 – GND
3 – Signal